

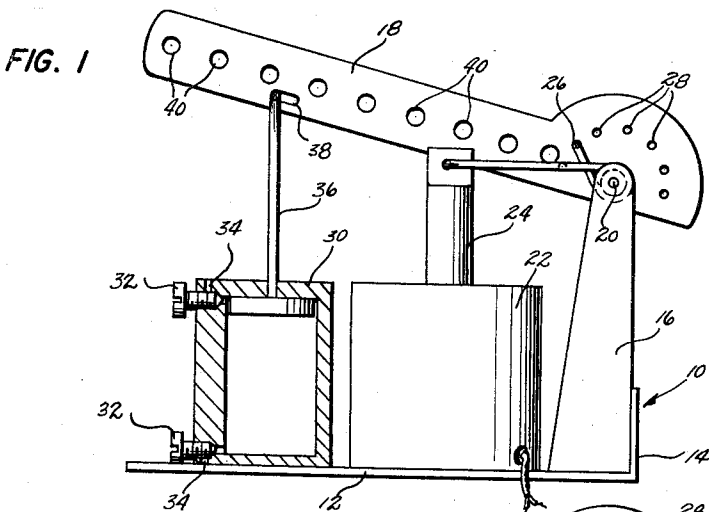
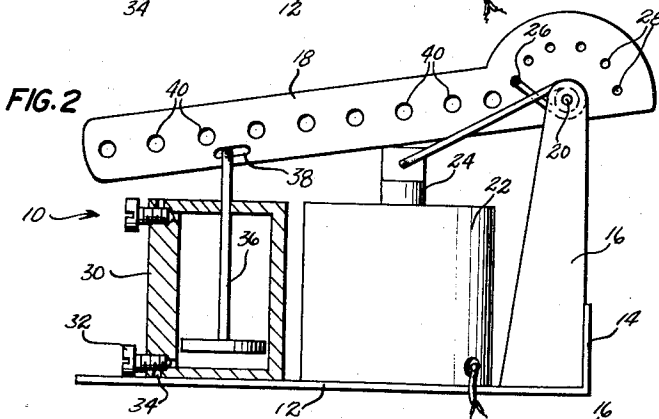
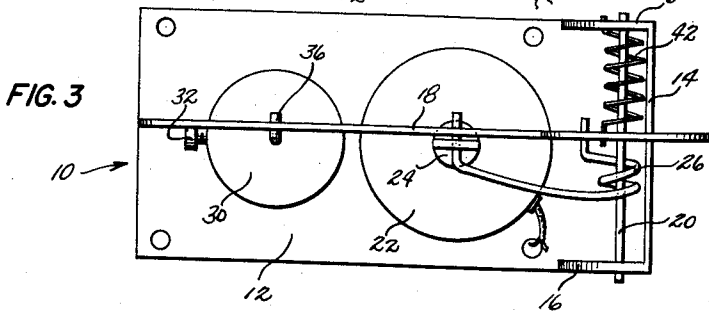
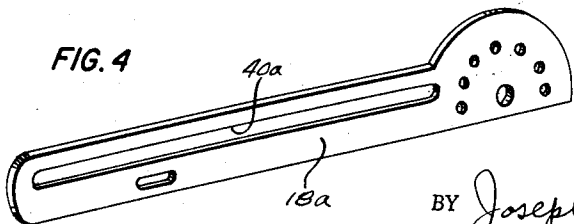
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SOLENOID ACTUATOR

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3,082,633

SOLENOID ACTUATOR

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This invention relates to actuators and more particularly to a multi-purpose, self-contained actuator unit relying on a solenoid for power.

I have found that solenoid actuators using a swinging arm connected to a buffer and receiving power through a spring interposed between the solenoid armature and arm have been described in prior patents, such as A. Sundh No. 745,926 and E. M. Paullin No. 2,088,174. Unfortunately, these disclosures have not resulted in commercially available actuators for general purposes. Sundh describes a control for an alternating current motor and Paullin describes a valve operating mechanism producing a time lag between solenoid energization and valve actuation. Apparently, these patentees did not conceive of their inventions as being multi-purpose solenoid actuators for general application and use. Furthermore, there are certain features of the patented devices such as lack of adjustments, which make them unsuitable as a general purpose, self-contained solenoid actuator.

Accordingly, an object of this invention is to provide a multi-purpose, self-contained actuator relying on the operation of a solenoid to transmit motivating force to an arm, making available a power take-off at selected places along the length of the arm whereby the desired stroke and mechanical advantage may be chosen by the user to suit his specific use.

One of the features of my invention is that I employ a double acting buffer, for instance a double acting dash pot, so that the motion of the arm is controlled during both the power stroke and return stroke.

Another feature of my invention is the spring which I have interposed between the solenoid armature and the arm under an adjustable preload, so that the driving force of the solenoid and the load attached to the swinging arm may be matched for optimum performance. This feature coupled with the multi-station power take-off makes my actuator more versatile than any other of which I am aware, and enables construction of a single unit which is satisfactory for many applications.

Other objects and features will become evident in following the description of the illustrated form of the invention.

FIGURE 1 is a side elevational view of my actuator showing it in the rest position.

FIGURE 2 is a side view similar to FIGURE 1, but showing the actuator in the operated position.

FIGURE 3 is a top view of the actuator.

FIGURE 4 is a perspective view of a modification showing a slightly different power take-off configuration for the arm of the actuator.

Actuator 10 (FIGURES 1-3) is composed of base 12 having an end wall 14 and provided with a pair of upstanding supports 16. The base, wall 14 and supports are preferably made as a single stamping. Power take-off arm 18 is mounted for pivotal movement on supports 16 by pivot pin 20.

A standard solenoid 22 is attached to base 12 near supports 16. This solenoid can be of the D.C. or A.C. variety. Instead of directly connecting the armature 24 to arm 18, I interpose spring 26 between the armature and arm so that the driving force of the solenoid is transmitted to the spring 26, and from the spring to the arm. When an ordinary A.C. solenoid is first energized the force is small and it builds up to a maximum at the end of the armature

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stroke while the current is initially large and decreases at the end of the stroke. Consequently the spring 26, by yieldingly receiving the driving force of the armature, prevents excessive currents and heat in the solenoid winding; prevents chattering of the solenoid when overloaded; and prevents the noise ordinarily accompanying A.C. solenoid actuation because the solenoid rapidly achieves the end of its stroke and presses against an abutment.

Spring 26 is shown as a torsion spring mounted on pin 20 and having one end in an opening in armature 24. The other end of the spring is disposed in a selected aperture 28, there being a group of such apertures (FIGURES 1, 2 and 4) near the pivot point of the arm. The spring is maintained under a selected preload by twisting it and placing the end of the spring into one of the apertures 28. The preload of the spring is maintained by having the lower edge of arm 18 rest on the upper end of the armature or the end-connection region of spring 26 with armature 24.

Buffer 30 is secured to base 12 to arrest the movement of arm 18. As shown in detail in FIGURE 2 the buffer 30 is double acting, having two adjustable screw-controlled orifices 32 and 34, or the like, communicating with the ends of the cylinder containing the piston of the buffer. Although I disclose an air dash pot as the buffer, other buffers such as an oil dash pot may be selected. In all cases, however, there is a mechanical connection between the moving part of the dash pot and arm 18. This mechanical connection may be simply an end 36 of the buffer piston rod fitted in a slot 38 in arm 18.

There are power take-off means 40 along the length of arm 18. One form of these means consists of spaced openings within which a fastener from an external load may be attached. Arm 18a (FIGURE 4) is a modification where the power take-off means are in the form of a slot lengthwise of the arm, allowing infinite adjustment between the limits of the ends of the slot.

In operation, assume that the actuator 10 is in the non-actuated position (FIGURE 1). Spring 26 is maintained under the preselected preload by having arm 18 bear against armature 24 or the region of the armature-spring connection. Upon energization of solenoid 22 one end of the spring is pulled downward (with reference to the orientation in the drawing), and the force is yieldingly transmitted to arm 18 which is assumed to be under an external load or resistance to movement whose nature will depend on customer use. As the armature applies force to the spring, the force is transmitted to arm 18 gradually as initially determined by the spring preload, and the position shown in FIGURE 2 is achieved but under the yielding opposition of buffer 30.

The user of actuator 10 may supply the return force for arm 18 to achieve the rest position (FIGURE 1). In that case spring 42 will be unnecessary, although it is supplied, just as mounting holes 44 in base 12, in case the user desires to take advantage thereof. A typical type of return spring compatible with actuator 10 is a light torsion spring attached to one of the supports 16 and to arm 18. Return spring 42 is mounted on pivot 16 on one side of the arm 18, while the main spring 26 is on the same pivot, but the other side of the arm.

When arm 18 is moved to the position shown in FIGURE 2, spring 42 is tightened. Although spring 42 is lighter than spring 26, it is sufficient to elevate arm 18 to the rest position shown in FIGURE 1 and overcome the yielding opposition to movement created by the upstroke of the buffer piston.

It is understood that various changes and modifications may be made without departing from the invention. For instance, spring 42 could be in another location or a different kind, and the type of buffer selected may vary

widely. Accordingly, all modifications falling within the scope of the following claims may be resorted to without departing from the protection of the claims.

I claim:

1. An adjustable actuator comprising a base, a solenoid fixed to said base and having an armature which moves when the solenoid is electrically energized, an upstanding support fixed to said base, an arm pivot connected to said support, an arm pivotally supported by said pivot, means along the length of said arm by which to engage an external load at selected positions of said arm so that the desired mechanical advantages and output stroke derived from the movement of said arm may be selected, a buffer fixed to said base and having a movable part pivotally connected to said arm at a place remote from said arm pivot, a torsion spring having one end directly connected to said armature, and connection means directly connecting the other end of said torsion spring to said arm, said torsion spring comprising the sole and direct drive connection between said armature and said arm, said connection means being adjustable to store a selected preload of potential energy in said spring so that said actuator may be adjusted to match the external load and thereby increase the range of operative usefulness of said actuator with different external loads, and the pre-

load stored in said torsion spring being in a direction tending to assist the electrical actuation of said solenoid but retained as potential energy stored in said spring by means of said arm engaging the first-mentioned end of said spring when said solenoid is in the non-actuated position.

2. The actuator of claim 1 wherein said connection means which adjustably connect said torsion spring to said arm include a series of apertures in said arm adjacent to said arm pivot to provide a selection of possible connection points for the adjacent end of said torsion spring.

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